

A CONCISE REVIEW OF FOREST FLORA OF KERALA¹

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Forest flora of Kerala is reviewed in the light of existing literature and occasional forest surveys carried out between 1984 and 1990. History of earlier botanical studies, phytogeography and vegetation, significance of the flora and its affinity with other floristic regions are discussed. The floristic diversity and status of endemic, rare and threatened species in Kerala are also examined.

The hilly state of Kerala which lies isolated from the Deccan Plateau by the mountainous belt of the Western Ghats occupies a geographical area of 38,864 sq.km. The State is, in fact, a narrow strip, 32 to 120 km in width stretching for about 565 km along the Malabar Coast on the western side of the peninsular India.

The State can be divided longitudinally into three geographical zones—Highlands, Midlands and Lowlands. Highlands exceed altitude of 900 m in the Western Ghats with numerous peaks, some well over 1850 m, the highest being Anaimudi, at 2680 m. Midlands lie between the mountains and the plains of the coastal region and are chiefly constituted by undulating hills and valleys. Lowlands, the coastal area, comprise river deltas, backwaters and the shores of the Arabian Sea.

When Kerala was inhabited for the first time, the population might have primarily been concentrated along the coast or scattered along the principal river banks. The rest of the land, in all probability, must have been a wilderness of trees. This primeval forest was gradually but thoroughly modified by human activities and domesticated animals. Shifting cultivation, intensive grazing, extensive plantations, rapid urbanization as well as industrialization and more over, massive explosion of population over about five thousand years devastated the rich forest cover almost entirely from the Lowlands, much from the Midlands and

to an extent even from the Highlands.

Highlands and Midlands harbour the principal forests of Kerala today. Midlands are the areas of intensive cultivation too for cash crops such as cardamom and rubber. Lowlands, however, are now essentially the land of coconut and rice. Forests in Kerala are presently estimated to cover 24% (9345 sq. km) of its total geographical area (Anonymous 1990) and of these, closed forests occupy only 17% (6609 sq. km) (Chandrasekharan *et al.* 1984); the remaining is estimated to represent open or degraded forest land.

1. History of earlier botanical studies: A land of spices, Kerala had been a trade centre for these commodities, especially black pepper, cardamom, cinnamon and ginger. Since 3000 B.C. Assyrians, Egyptians, Greeks, Arabs and afterwards Europeans had come to this land lured by spices. But it was Heinrich van Rheede, the Dutch Governor at Cochin, who took interest in the luxuriant vegetation of the State and published a monumental work on the plants of Malabar 'Hortus Malabaricus' between 1678 and 1703 in 12 volumes illustrated with the assistance of local artists. He described 742 plants.

From 1872 to 1897 Hooker published a comprehensive flora of British India in 7 volumes helped by leading botanists of the time. Hooker's work referred to many places and plants from Kerala. 'A Manual of Malabar District' by William Logan published in 1887 has included descriptions of forests and forest trees of British Malabar. Bourdillon, the then Forest Conservator, wrote in

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1893 'Reports on the forests of Travancore' after combing and crisscrossing 11,200 km of Travancore forests. He described the vegetation keeping rivers as the basis and dealt with nature and biotic relationship of forests in the light of historical facts. This helped him later to publish the book 'Forest trees of Travancore' in 1908. 'Flowering Plants of Travancore', another work published in 1914 by Rama Rao, the then Conservator of Forests, is also a significant contribution to the botany of southern Kerala.

In 1915 Gamble, an English botanist, started publishing 'Flora of the Madras Presidency' and this serial was completed by Fischer in 1936. The work covered many forest areas within the present political boundary of Kerala. Other works which deserve mention are the series of papers published on ecology of Kerala forest (Chandrasekharan 1962), Flora of Calicut (Manilal and Sivarajan 1982), Plantation and Agri-Horticultural Resources of Kerala (Nair 1984a), Economic Botany of Kerala (Nair 1984b), Kerala Forest through Centuries (Karunakaran 1985), Forest Plants of Kerala (Nair and Nair 1985), Study on wet evergreen forests of the Western Ghats (Pascal 1988) and Flora of Silent Valley (Manilal 1988). The revisionary attempt made by Nicolson *et al.* (1988) in establishing the correct identity of plants mentioned in 'Hortus Malabaricus' is a noteworthy contribution to the floristic study of Kerala in particular and to taxonomy in general. Van Rheede's illustrations in 'Hortus Malabaricus' are the types of many Linnean genera and species.

Presently the Coimbatore based regional circle of the Botanical Survey of India is engaged in the exploration of the forest flora of some districts of Kerala; Kerala Forest Research Institute, Tropical Botanic Garden, French Institute of Pondicherry, Department of Botany, Calicut University and Botany Departments of a few colleges in the State are also active in this and related fields.

2. Phyto geography and Vegetation: The Vegetation of India has been phytogeographically analysed and divided into several botanical provinces based on criteria like species-content of the families (Clarke 1898, Hooker 1907), humidity or dryness (Prain 1903) and the distribution of endemic species (Chatterjee 1940). Kerala comes under the 'Malabar' botanical province (India

aquosa of Prain, l.c.) which extends along the western side of peninsular India through the humid tropical belt of mountain ranges in the Western Ghats from the river Tapti in South Gujarat to Kanyakumari in Tamil Nadu.

Adjacent to 'Malabar' is the botanical province 'Deccan'. The 'Malabar' flora gradually merges through the leeward side of the Western Ghats with the floristic components of 'Deccan'. Though there exists no clear-cut boundaries between these provinces, Hooker (1907) observed that the most distinctive characteristics of 'Malabar' flora, in contrast to that of 'Deccan', are primarily the occurrence of species belonging to Arecaceae, Bambusaceae, Clusiaceae, Dipterocarpaceae and Myristicaceae and secondarily the abundance in species of Malayan character, especially plants belonging to the families Anacardiaceae, Araceae, Gesneriaceae, Melastomataceae, Meliaceae, Myrtaceae, Orchidaceae, Piperaceae, Tiliaceae and Zingiberaceae.

Another outstanding feature of 'Malabar' botanical province is the development of tropical rain forests in the Western Ghats especially on the windward side of the southern Ghats between 500 to 1500 m. (Subramanyam and Nayar 1974).

3. Forest Types: The vegetational luxury of Kerala and its unusual wealth of variety, unique for so small a region, are mainly due to the diverse range in altitude and the resultant variation in rainfall, temperature and humidity. Based on these factors, forests in Kerala are brought mainly under 3 types: 1. *Wet Evergreen (rain) Forests*, 2. *Moist Deciduous Forests* and 3. *Dry Deciduous Forests* (Ayyar 1932, Champion 1936, Chandrasekharan 1962, Subramanyam and Nayar 1974, Pascal 1988). In the hills exceeding 1500m, Meher-Homji (1967, 1969, 1984, 1985, 1987-88) has recognised (1) *Shola (tropical montane forest)*, (2) *Trees and Shrubs zone at the fringe of the Shola*, (3) *Shrub-Savanna* and (4) *Grassland*. *Myristica* swamps described by Krishnamoorthy (1960) and Chandrasekharan (1962) are of sporadic occurrence in the State and are very rare today.

Physical features and physiographic as well as biotic factors intervene in determining and modifying the natural vegetation and Kerala is no exception. Classifying the forests which are always

dynamic into various types is only an attempt to define the more stable communities based on ecological concepts. Intergrading of different types with various combinations of ecotones is a natural phenomenon. To quote Champion (1936) "it is difficult to classify vegetation in general and of tropical countries in particular."

4. Affinities of the flora: The Indian sub-continent was part of the Gondwana land and the past connections of peninsular India with the now separated continents have been phytogeographically proved through the occurrence of various genera like *Acrotrema* (Dilleniaceae), *Hydnocarpus* (Flacourtiaceae), *Laurembergia* (Haloragaceae), *Hernandia* (Hernandaceae), *Apodytes*, *Gomphandra*, *Nothapodytes* and *Sarcostigma* (Icacinaceae) (Nayar 1980b). *Poeciloneuron* (Clusiaceae), now assigned to Bonnetiaceae, occurring in the Western Ghats has many allied genera in South America (Nayar 1977).

Genera like *Poeciloneuron* (Clusiaceae), *Acrotrema* (Dilleniaceae), *Hydnocarpus* (Flacourtiaceae), *Gomphandra*, *Nothapodytes*, *Sarcostigma* (Icacinaceae) and *Pittosporum* (Pittosporaceae) occur in the Forests of Kerala and are the characteristic components of the vegetation. *Dorstenia indica* Wall. (Moraceae) occurring in the Western Ghats including Kerala has its counterparts in *D. asteriscus* Engl. in Tropical Africa and *D. radiata* Lam. of Arabia (Corner 1981). Abraham and Vatsala (1981) enumerated 10 genera of Orchidaceae, namely *Acampe*, *Bulbophyllum*, *Disperis*, *Enlophia*, *Habenaria*, *Liparis*, *Nervilia*, *Oberonia*, *Satyrium* and *Vanilla* as of common occurrence in the Western Ghats and Africa. All these genera, except *Satyrium*, are well represented in Kerala. 15 species of bryophytes are of common occurrence in peninsular India and East Africa (Schuster 1976).

The flora of the Western Ghats in Kerala holds substantial phytological affinity with the Malaysian region (Hooker 1907, Subramanyam and Nayar 1974). The recent finding by Mohanan and Nair (1981) that Malaysian genus *Kunstleria* (Fabaceae) is represented in Kerala by the species *K. keralensis* Mohanan and Nair also adds to the above observations.

The flora of Kerala presents striking similarity

with that of Sri Lanka. *Dorstenia indica* Wall. (Moraceae) which is part of the *Dorstenia* complex occurring in Arabia and Africa is present both in Kerala and Sri Lanka; the monotypic *Kendrickia walkeri* Hook. f. (Melastomataceae) present in Anaimudi and Adam's peak, the highest peaks in Kerala and Sri Lanka respectively also stress this similarity (Subramanyam and Nayar 1974). The Indo-Sri Lanka genus *Humboldtia* (Caesalpiniaceae), is represented in Kerala by *H. bourdillonii* Prain, *H. decurrens* Bedd. ex Oliver and *H. unijuga* Bedd., *Thrixspermum pulchellum* (Thw.) Schltr. (Orchidaceae), recently reported from Palode forest of Trivandrum district, is earlier recorded only from Sri Lanka (Sathishkumar 1986a). *Huperzia ceylancia* (Spr.) Trev., *H. vernicosa* (Hook. et Grev.) Trev. and *Diphasiastrum wightianum* (Wall. ex Hook. et Grev.) Holub. (Lycopodiaceae) occur only in Sri Lanka apart from Kerala and Tamil Nadu (Nair *et al.* 1988). Ramachandran and Nair (1988) have enumerated a number of species common to both Cannanore district of Kerala and Sri Lanka. the occurrence of 'Patenas' in Sri Lanka and montane grasslands in Kerala at the same elevation also manifests the vegetational resemblance between these two countries. Mohanan (1981) is of the opinion that the flora of Quilon district combines the floristic elements of Malabar and Sri Lanka. Then there are species like *Leea indica* (Burm. f.) Merr. (Leeaceae) frequently seen in the forests of Kerala and rest of Peninsular India, that are also common in Australia.

It is evident that the floristic diversity of Kerala like that of the Western Ghats is of an ancient lineage. Such an ancient flora is not just a reservoir of botanical antiques but is a dynamic biological source where speciation is taking place at an accelerated speed (Ashton 1977).

Of about 15,000 species of flowering plants estimated to occur in India, about 4000 are found in the Western Ghats (Nair and Daniel 1986). Available botanical evidence suggests that the State of Kerala is phytogeographically an integral part of the Western Ghats which shares its endemics with the State.

Bourdillon (1893) dealt with 582 indigenous trees from Travancore alone. Rama Rao (1914) recorded 3535 flowering plants from Travancore

though he did not claim that his work was wholly based on exploratory surveys. Manilal and Sivarajan (1982) surveyed Calicut district and recorded 983 angiosperms from the area. Exploration of 39,100 ha in and around Silent Valley (Palghat district) has produced over 1,300 species of angiosperms (Nair and Daniel 1986). Vajravelu (1987) reported 1208 angiosperm species from Palghat district but later increased the number to 1355 (1990). Subramanian *et al.* (1987) recorded 757 arborescent species from Palghat forest division which comprised of Palghat and Perinthalmanna talukas of Palghat district and Ernad taluka of Calicut district. Manilal (1988) reported 966 angiosperm species from Silent Valley. Mohanan (1981) recorded 700 flowering plants from Trivandrum district. Though Ramachandran (1981) initially estimated that Cannanore district has 825 angiosperm species, Ramachandran and Nair (1988) recorded 1132 species from the district. An exploratory study of Kerala grasses has revealed that the State has 296 species of Poaceae inclusive of 2 new genera and 26 new species (excluding Bambuseae) (Sree Kumar and Nair 1991). 742 plants illustrated and described by Van Rheede, according to Nicolson *et al.* (1988), represent 690 taxa. Of these, 660 species were collected by them again in and around their original locations, i.e. the erstwhile Cochin State. It can be estimated that the whole state, when exhaustively explored, may have well over 4,000 angiosperm species.

As for the other groups of plants, common gymnosperms represented in the forests are *Cycas circinalis* L. (Cycadaceae) and *Gnetum ula* Brogn. (Gnetaceae); *Gnetum contractum* Markg. is of very rare occurrence in the State. *Decussocarpus wallichianus* (Presl) Laub. (Podocarpaceae) has been recorded at Kochu Pamba beyond Anathode and sporadically within the nearby Goodrical reserve forests in Pathanamthitta district (Chand Basha, KFRI-personal communication). It also occurs at Agastyar Hills, but within the boundary of Tamil Nadu state. No serious work has been published on the pteridophytic flora of Kerala except the first of the envisaged three parts by Nair and his associates (1988). The work is based on explorations conducted in the State between 1968 and 1983. They classified the pteridophytic vegetation on physiographic basis as belonging to 1. Coastal zone, 2. Middle zone and

3. Eastern mountainous zone and enumerated characteristic species of these zones. Ferns and fern-allies of Kerala representing 33 pteridophytic families have been accounted and Kerala has a very rich fern flora.

A lone exploration in Silent Valley itself has resulted in recording 78 species of ferns including one new species of *Pteris* (Aspidiaceae) (Vohra *et al.* 1982). About 55 species of bryophytes have been collected from the recently formed Idukki district and of these 14 taxa are additions to South India (Rajeevan 1985). Vohra *et al.* (1982) have reported 83 species including 3 new species of bryophytes from the Silent Valley.

5. Endemic, rare and threatened flora:

Endemic plants are the taxa which enjoy very restricted distribution because of geographical and/or ecological barriers. Peninsular regions are almost identical to islands in having conditions that favour endemism (Turrill 1964). Blasco (1970) observed that South Indian hill tops are rich in endemic species. But historically the flora of peninsular India is impoverished due to the flow of Deccan lava during the Cretaceous-Eocene and the spread of aridity in the Neocene and the Quaternary which resulted in the depletion of her characteristic flora leaving a few relic endemic taxa in the region (Nayar 1980a). According to Nayar (1980b) 56 genera and about 2,100 species of flowering plants of peninsular India, most of them confined to the Western Ghats, are endemic.

Though, as earlier stated, phytogeographically the State shares its endemism with the Western Ghats, a number of new species of angiosperms have been recorded from Kerala, especially of late and most of them are not reported from anywhere else in the Western Ghats. This may be due to the fact that the species are niche-specific. Such new species include *Lagenandra nairii* Ramam. & Rajan (Araceae), *Tylophora subramanii* Henry (Asclepiadaceae), *Euphorbia santapau* Henry (Euphorbiaceae), *Zornia quilonensis* Ravi (Fabaceae), *Laurembergia agastyamalayana* Henry (Holaragidaceae), *Luisia abrahamii* Vatsala, *Oberonia bisaccata* Manilal & Sathish, *Trias bonaccordensis* Sathish, *Cheirostylis seidenfadeniana* Sathish and Rasm. (Orchidaceae), *Dimeria keralae* N.C. Nair, Sreekumar & V.J. Nair (Poaceae), *Dicraea filifolia* Ramam. & Joseph

(Podostemaceae), *Hedyotis gamblei* Henry & Subr., *Psychotria sekharana* (Ramam. & Rajan (Rubiaceae) and many others.

Endemic genera of Kerala are *Kanjarum* (*K. palghatensis* Ramam., Acanthaceae), *Janakia* (*J. arayalpatra* Joseph & Chandr., Asclepiadaceae), *Oianthus* (*O. beddomei* Hook. f., Asclepiadaceae), *Haplothismia* (*H. exannulata* Airy Shaw, Burmanniaceae), *Meteoromyrtus* (*M. wynaadensis* (Bedd.) Gamble, Myrtaceae), and *Limnopoia* (*L. meeboldii* (Fisch.) Hubb.), *Chandrasekharania* (*C. keralensis* V.J. Nair *et al.*) and *Silentvalleya* (*S. nairii* V.J. Nair *et al.*) (all Poaceae).

Some genera having their endemic species in Kerala include *Humboldtia bourdillonii* Prain (Caesalpiniaceae), *Erythralum populifolium* Mast. (Erythralaceae), *Pseudoglochidion anamalayanum* Gamble (Euphorbiaceae), *Inga cynometroides* Bedd. (Mimosaceae), *Antistrophe serratifolia* Hook. f. (Myrsinaceae), *Myxopyrum smilacifolium* B1. (Oleaceae), *Cymbopogon travancorensis* Bor (Poaceae), *Octotropis travancorica* Bedd. (Rubiaceae) (Subramanyam & Nayar 1974), *Blepharistemma membranifolia* (Miq.) Ding Hou (Rhizophoraceae) (Mohanan 1981), *Dalbergia beddomei* Thoth., *D. travancorica* Thoth. (Fabaceae) (Nair 1986), *Brachycorythis splendida* Summerh., *Diplocentrum congestum* Wt. and *Paphiopedilum druryi* (Bedd.) Stein (Orchidaceae) (Sathishkumar 1986b). Further plant explorations of under explored and unexplored vegetational pockets of the State are likely to result in increase in the number of endemic and/or new taxa of Kerala; it is also likely that intensive and extensive floristic explorations of the Western Ghats may reveal the presence of some of the taxa presently endemic to Kerala in other regions of the Western Ghats.

Since endemic plants enjoy restricted distribution they become extinct when their natural habitats are destroyed. Biotic interference and deforestation have made even many a non-endemic species extinct. According to Raven (1977) about 63.3% of the tropical rain forests in India, Burma and Sri Lanka have been destroyed for human use up to 1975.

In Kerala the condition appears equally grave. About 3,500 sq. km of forest lands were transformed into non-forestry purpose between 1950-1970 (Nair

and Daniel 1986). This is apart from the destruction of natural forest for 'productive purposes' like plantations of tea, coffee, rubber and various other intentions including monoculturing of economically important exotic tree like *Eucalyptus*. Over exploitation of plants from the forest for use in the indigenous systems of medicine also accelerates the process of destruction of individual species.

Coscinium fenestratum Colebr. (Menispermaceae), once a common species in the forests of Kerala, is a good example to substantiate this assertion. More than 500 species of plants with high medicinal value have been recorded from the State (Anonymous 1981, Nambiar *et al.* 1985). Construction of small as well as big dams is another factor which destroys vast areas of forest. Destruction of forest at such an alarming rate has destroyed the habitats of many species which are endemic or niche-specific.

We do not have a clear account of endemic, rare or threatened flora as our knowledge on Indian flora is still not exhaustive. This is because many parts of Indian forests even now remain underexplored or totally unexplored. As for the Western Ghats, an essay based on available literature shows that about 700 species of flowering plants, most of them endemic or niche-specific, are reportedly rare or threatened (Henry *et al.* 1979, Jain and Sastry 1980, Raghavan and Singh 1983, Vajravelu and Daniel 1983). Out of 38 species described by Beddome from Anaimalai, only five species could be collected by the latter explorers till now and the rest 33 are known only by the type collections (Raghavan and Singh 1983). In all possibility, they might have become extinct due to habitat destruction. *Paphiopedilum druryi* (Bedd.) Stein (Orchidaceae) described from Agastyamala is now considered to be extinct as it could not be relocated afterwards with the sole exception of the report made by Mammen and Mammen in 1974.³ Kammathy (1983) observed that most of the Commelinaceae species occurring at Agastyar hills are endemic, rare or threatened. Sivadasan (1983) pointed out that about 18 species of Araceae in

³The *Mathrubhumi*, a malayalam daily, dated 16th February 1992 reported that Dr. J. Joseph, Ex-Joint Director, BSI spotted out a small population of *Paphiopedilum druryi* at Kalaikkad in Agastyar Hills.

peninsular India are extremely rare because of the destruction of their habitats. It has been shown that the type locality of *Haplothismia exannulata* Airy Shaw (Burmanniaceae) has been submerged due to the construction of Parambikkulam Dam (Ramamurthy and Chandrasekharan 1981). *Asplenium grevillei* Wall. ex Hook. et Grev. (Aspleniaceae), a very rare and threatened species of fern occurring in association with the *Myristica* swamp at Kulathupuzha in Quilon district until 1979 could not be located afterwards and subsequently disappeared from the locality as the swamp was drained and the trees removed (Nair *et al.* 1988).

Intensive explorations in several parts of Kerala have resulted in finding out rare and imperfectly known species after a lapse of several years. Based on such fresh collections, descriptions of taxa like *Rostellularia simplex* (Thunb.) Ellis (Acanthaceae), *Dioscoria wightii* Hook. f. (Dioscoriaceae), *Apama barberi* Gamble (Aristolochiaceae), *Memecylon subcordatum* Cogn. (Melastomataceae), *Piper barberi* Gamble (Piperaceae) and *Glycosmis macrocarpa* Wt.

(Rutaceae) have been amended (Henry and Subramanyam 1981). Likewise, recent explorations in Quilon district alone have produced new distributional records in India for *Limnocharis flava* (L.) Buch. (Butomaceae), *Leptaspis urceolata* (Roxb.) R. Br. (Poaceae), *Mitracarpus villous* (Sw.) De. and *Spermacoce latifolia* Aubl. (Rubiaceae) (Mohanan 1981). It is also of interest that *Syzygium montanum* (Wight) Gamble earlier regarded as endemic to Nilgiris in Tamil Nadu was collected from Chanthanathode, Cannanore district (Ramachandran *et al.* 1980). Therefore intensive exploration of the forests of Kerala may change giving a new phytogeographical dimension to the flora's lineage and linkage.

The destruction of natural habitats warrants intensive and extensive study of flora of the State to determine the status of each species and its ecological requirements. Accordingly conservation strategies are to be framed to accommodate the species either in natural habitats like Wild-Life Sanctuaries, Biosphere Reserves and Biodiversity Conservation Regions or in artificial habitats like Botanic Gardens.

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